



RMA Investment Group
1-5 Railway Street
Suite 603 North Tower Chatswood Central
Chatswood NSW 2067

Ref: 115062/L160105

6 January 2016

Attention: Mr Delong Li

Dear Delong,

**Re: Lot 22 DP 791884 Palmers Lane Pokolbin
Site Flood Study**

1. Introduction

WMAwater was engaged by JW Planning to undertake a minor flood study for the site at Lot 22 DP 791884, Palmers Lane, Pokolbin NSW. JW Planning is managing due diligence investigations relating to the development potential of the site. There is an existing ephemeral creek running through the property, and the aim of the study was to understand flood behaviour to determine the development potential of the site. The study area is shown in Figure 1.

There is no existing information available relating to flood behaviour on the site. WMAwater has previously completed a flood study of Black Creek for Cessnock City Council (December 2015), but it did not include detail of the upper catchment area where the site is located. As such, WMAwater has undertaken a localised flood study to determine the following:

- Extent and depth of flooding across the site under existing conditions, for a range of flood magnitudes (including overland flow across the existing developed area);
- Appropriate finished floor levels for potential future development;
- Flood hazard (risk to life) and access/evacuation considerations for future development.

The technical flood modelling work undertaken for this study can be utilised for informing a subsequent Development Application (DA) at the site, however it is likely some additional refinement of the modelling will be required, depending on council requirements.

2. Scope

In preparation of this report WMAwater has undertaken the following tasks:

- a) Review of flood-related Council requirements;
- b) Flood modelling:
 - Localised refinement of the hydrologic model used in the Black Creek Flood Study (WMAwater 2015); and

WMAwater Pty Ltd (Formerly Webb McKeown and Associates)

DIRECTORS

M K Babister BE(Hons), MEngSc GradDipMgt, FIEAust
R W Dewar BSc(Hons), MEngSc, MAIG, MIEAust
E J Askew BE(Hons), MIEAust
S D Gray BE, MEng

ASSOCIATES

R Hardwick Jones BE(Hons), MEngSc, MIEAust
M E Retallick BE(Hons), BSc, MIEAust

ABN 14 600 315 053

Level 2, 160 Clarence St, SYDNEY NSW 2000
Phone: 02 9299 2855 Fax: 02 9262 6208
Email: enquiry@wmawater.com.au
Website: wmawater.com.au

- Development of a 2D TUFLOW hydraulic model of the site and surrounding area; and
- c) Mapping of existing flood behaviour for a range of design storm events.

3. Methodology

Light Detection and Ranging (LiDAR) aerial survey data was obtained from the NSW Department of Land and Property Information. Hydrologic modelling completed for the Black Creek study (WMAwater, 2015) was refined locally to provide additional detail of the local subcatchments in the vicinity of the site. Figure 2 illustrates the subcatchment delineation used in the hydrologic model.

The Palmers Lane site was not included in the hydraulic model from WMAwater (2015). A new 2D TUFLOW hydraulic model was therefore built for this study using the following parameters:

- Grid size of 2 m;
- Estimation of roughness using a Manning's n dependent on surface

Type	Manning's n	Surface Description
1	0.04	General
2	0.02	Paved Road
3	0.05	Light Vegetation
4	0.08	Heavy Vegetation
5	0.035	Ponds

Figure 3 shows the variation of Manning's n used across the site and indicates the boundaries of the hydraulic model.

The model was not calibrated to historical flood events, due to a lack of any observed flood data for the site. There are no relevant stream gauges to provide a flood history relevant to the site. Modelling was therefore undertaken in accordance with the design storm flood estimation procedures outlined in Australian Rainfall and Runoff (IEAust, 1987).

WMAwater modelled the 5% AEP, 1% AEP and PMF flood events to determine:

- Flood depths and contours of flood level;
- Flow velocities; and
- Flood hazard categories, based on Figure L2 of the Floodplain Development Manual (NSW Government, April 2005), which can provide an indication of risk to life and vehicles.

A range of storm event durations from 30 minutes to 18 hours were modelled to determine the critical duration for flooding on the site. The critical duration for peak flood levels was found to be the 9-hour storm for the 5% and 1% AEP events, and the 2-hour storm for the PMF event.

4. Modelling Results

The proposed development site is located within the Black Creek Catchment. The site and the surrounding study area contains a number of creeks, which can be seen from the ground level contours shown on Figure 4. Mary Annes Creek, a tributary of Black Creek, runs from the west of the study area to the north, just west of the site.

The flood levels and depths are shown on Figure 5 to Figure 7 for the 5% AEP, 1% AEP and PMF respectively. The main flooding is along Mary Annes Ck and due to the natural topography, the floodplain is well confined as shown in the figures. Floodwaters from this creek do not impact the proposed development site in the 5% or 1% AEP, however there is some impact in the northwest corner of the site in the PMF.

A smaller tributary of Mary Annes Ck runs through the proposed site from the southeast to the northwest, meeting Mary Annes Ck to the north. As there is onsite flooding associated with this creek it is expected that flood planning levels are to be based on this particular creek. Due to the natural topography sloping from south to north, there is a significant difference in the 1% AEP flood level across the site, and therefore minimum floor level requirements for future development will vary across the site.

Another small creek to the east of the site flows into Mary Annes Creek but does not affect the development site, however it may affect access to Palmers Lane during a flood event. This may require consideration in hazard and evacuation planning as part of any proposed development.

The depth and velocity maps for the modelled events should be considered when planning access to the development site. It is understood that a new road would need to be constructed, to provide access to the site. Design of this road would require consideration of appropriate levels of flood immunity for locations where the road crosses the existing creeks and their floodplains.

The peak flood velocities are shown on Figure 8 to Figure 10 for the three modelled events, with the highest on-site velocities occurring in the central south region of the site.

The hydraulic hazard categories for each of the 5% AEP, 1% AEP and PMF events are shown on Figure 11 to Figure 13. Areas affected by high hazard in the PMF event may require further consideration as part of evacuation and access planning for a development proposal on the site.

5. Flood related development controls

WMAwater understands that Council are currently refining flood-related development controls as part of a Development Control Policy (DCP), however the completion date is unknown. The planning landscape is changing within the Cessnock LGA, and JW Planning should be aware that requirements for development may change between the time of this study and submission of a DA for the site. Currently, Council provides a Fact Sheet available on their website, which contains broad requirements addressing floor levels, evacuation, and impact controls as set out in Cessnock Local Environmental Plan (CLEP) 2011.

An excerpt from the LEP is included below:

Clause 7.3 [of the CLEP] aims to minimise the flood risk to life and property, permit development on land that is compatible with the land's flood hazard, and avoid significant adverse impacts on flood behaviour and the environment. Clause 7.3 applies to land at or below the 'flood planning level'. Clause 7.3 also identifies matters to be considered during the assessment of a development application on flood prone land. Specifically, Clause 7.3(3) states as follows:

- 3) *Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:*
- a) *is compatible with the flood hazard of the land, and*
 - b) *is not likely to significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*
 - c) *incorporates appropriate measures to manage risk to life from flood, and*
 - d) *is not likely to significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and*
 - e) *is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.*

Cessnock City Council requires finished floor levels for most developments to have 0.5 m freeboard above the 1% AEP flood level.

6. Notes and Limitations

The Flood Study was carried out in accordance with the *New South Wales Floodplain Development Manual* (NSW Government 2005) and *Australian Rainfall and Runoff* (IEAust 1987).

It should be noted that the modelling undertaken for this site is preliminary and has not been calibrated to historical events. The outputs have been generated solely for the purpose of understanding flooding behaviour and potential constraints for development. The contents of this report are confidential and should not be reproduced without express permission of the client. The outcomes of this study should not be relied upon for purposes other than the objectives stated in this report.

7. References

Cessnock City Council, 2011, *Cessnock Local Environment Plan*.

Cessnock City Council, 2014, *Planning and Environment Fact Sheet 16 – Development on Flood Prone Land*, Revision No. 24-09-2014.

NSW Government, 2005, *Floodplain Development Manual – The Management of Flood Liable Land*.

Pilgrim, D. H (Editor in Chief), 1987, *Australian Rainfall and Runoff – A Guide to Flood Estimation in Australia*, Engineers Australia.

WMAwater, 2015, *Black Creek Flood Study – Stage 2 (Nulkaba to Branxton)*, Cessnock City Council.

Attachments:

Figure 1: Study Area

Figure 2: Subcatchment Delineation

Figure 3: Hydraulic Model Schematisation

Figure 4: Ground Level Contours from LiDAR

Figure 5: Peak Flood Levels and Depths – 5% AEP

Figure 6: Peak Flood Levels and Depths – 1% AEP

Figure 7: Peak Flood Levels and Depths – PMF

Figure 8: Peak Flood Velocities – 5% AEP

Figure 9: Peak Flood Velocities – 1% AEP

Figure 10: Peak Flood Velocities – PMF

Figure 11: Hydraulic Hazard – 5% AEP

Figure 12: Hydraulic Hazard – 1% AEP

Figure 13: Hydraulic Hazard – PMF

I trust the above meets your present requirements. Please do not hesitate to contact me for clarification of the above.

Yours faithfully,

WMAwater

A handwritten signature in blue ink, appearing to read 'Rhys H-Jones'.

Rhys Hardwick Jones

Associate

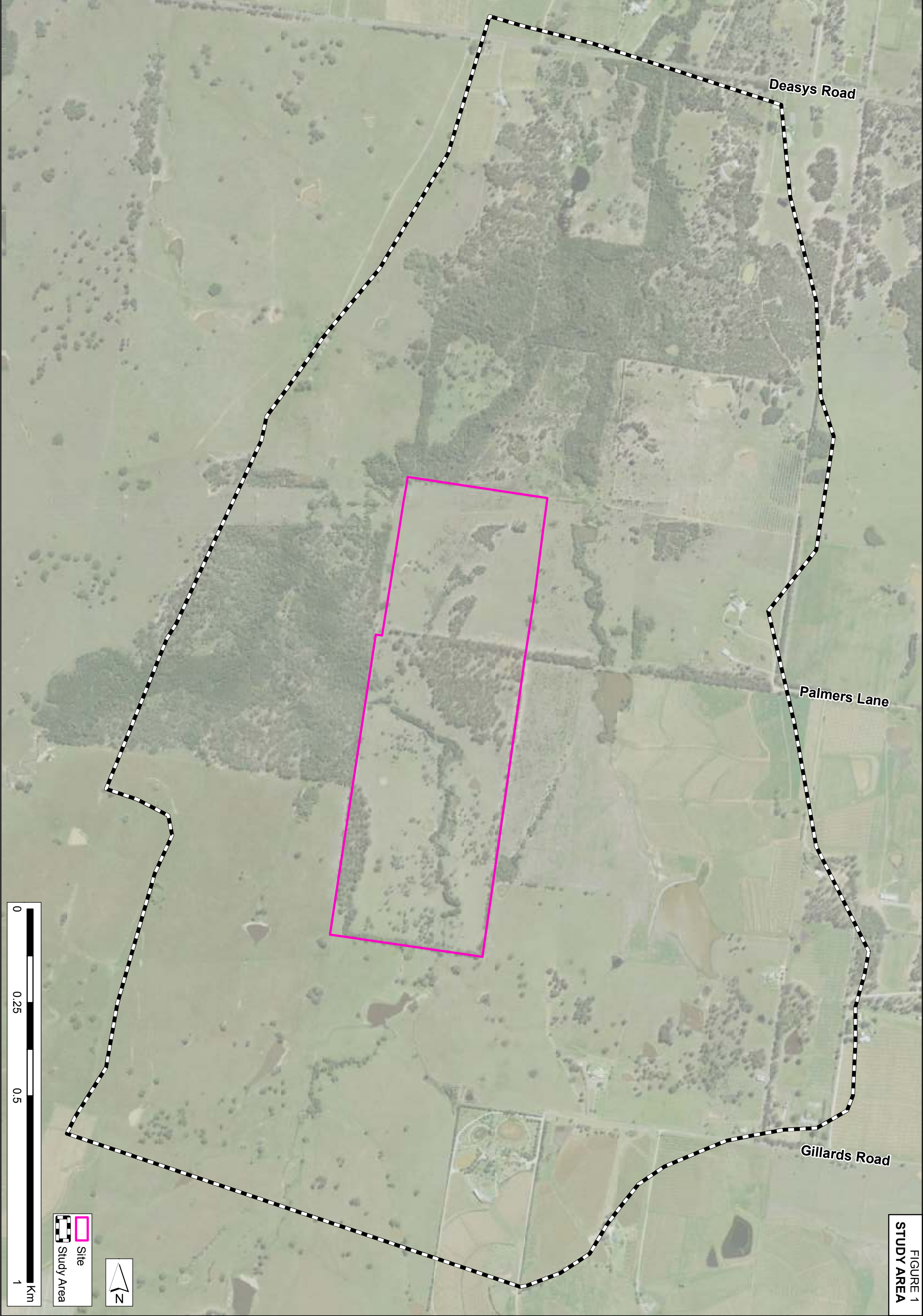


FIGURE 1
STUDY AREA

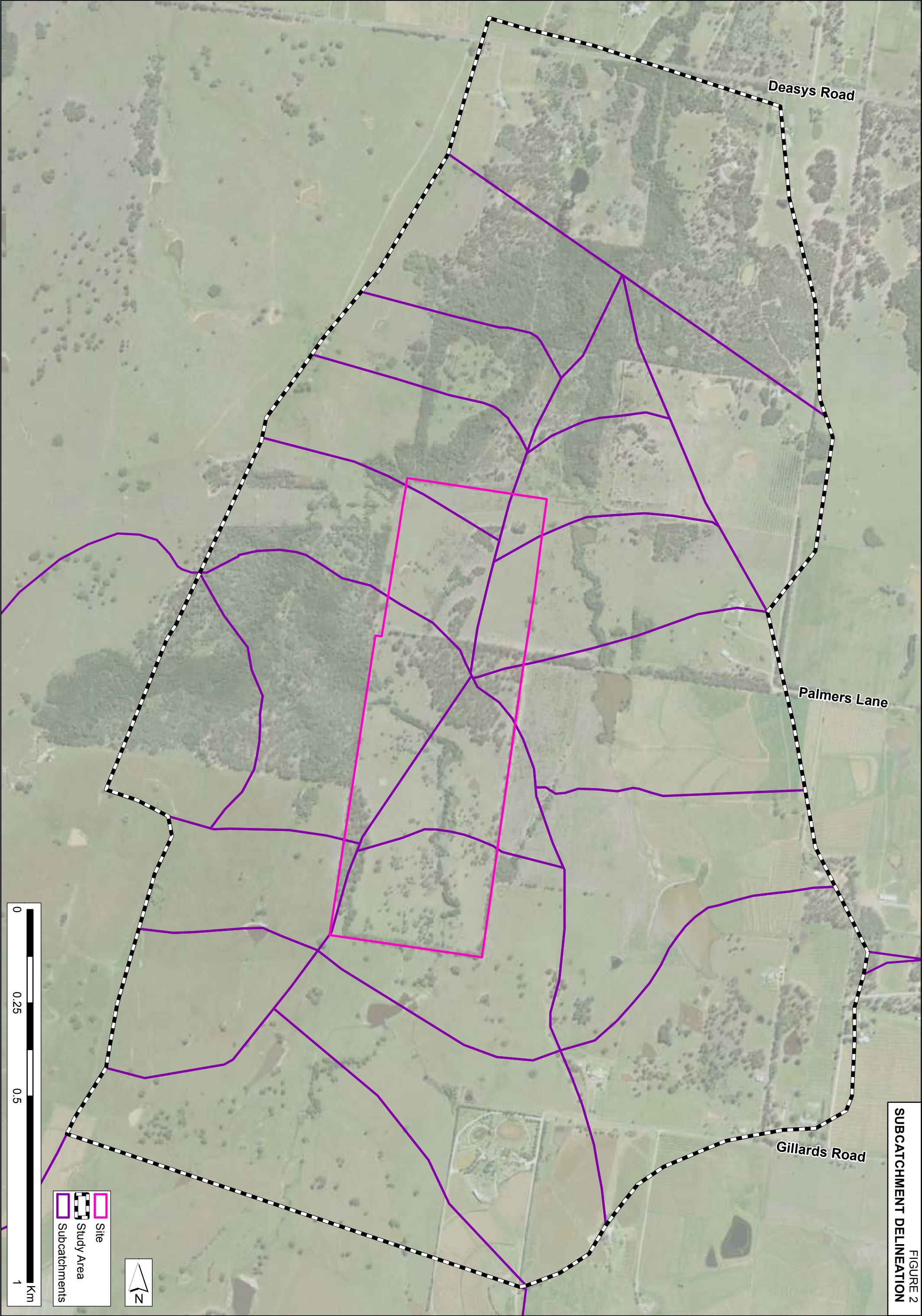


FIGURE 2
SUBCATCHMENT DELINEATION

FIGURE 3
HYDRAULIC MODEL

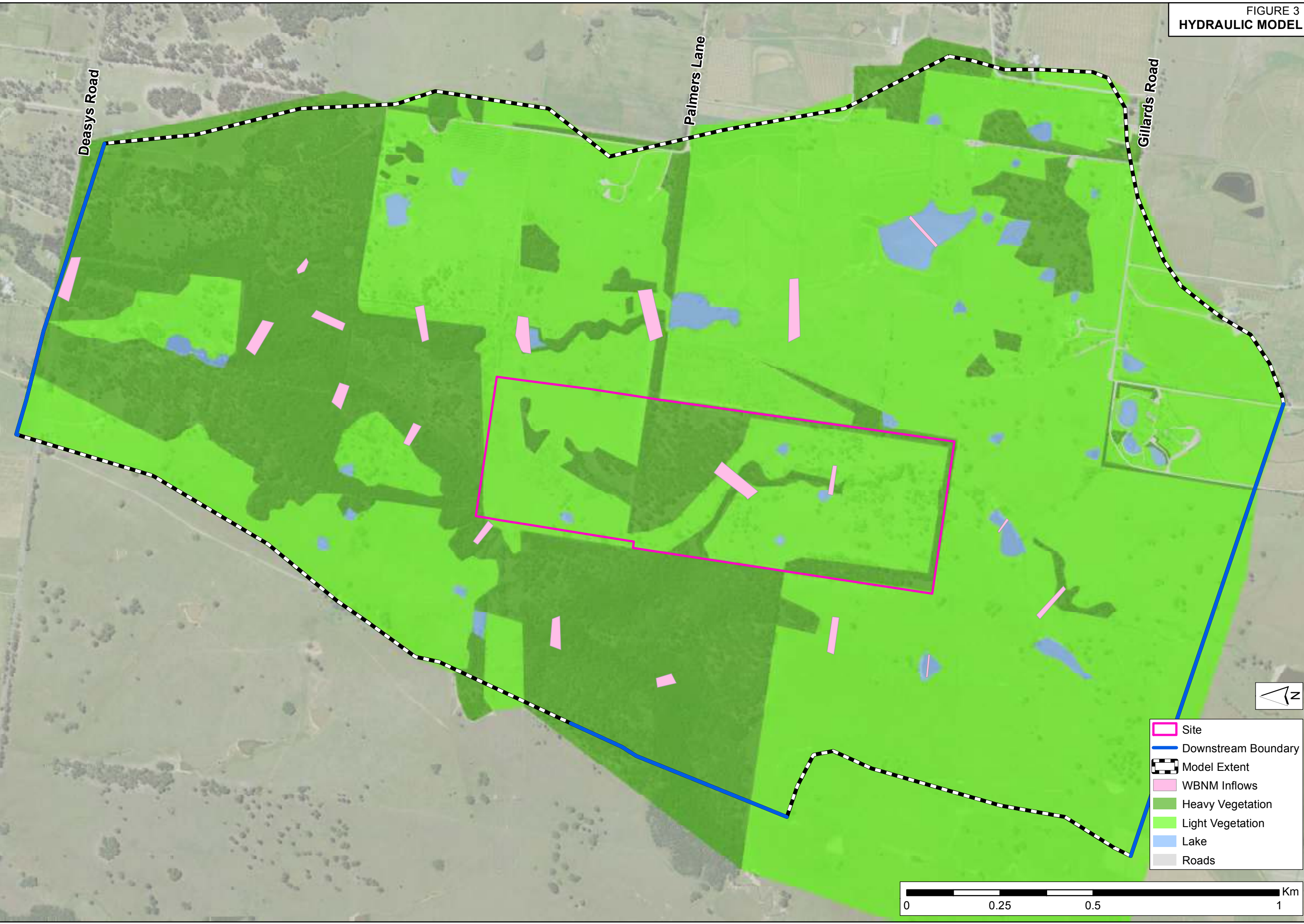


FIGURE 4
GROUND LEVEL CONTOURS

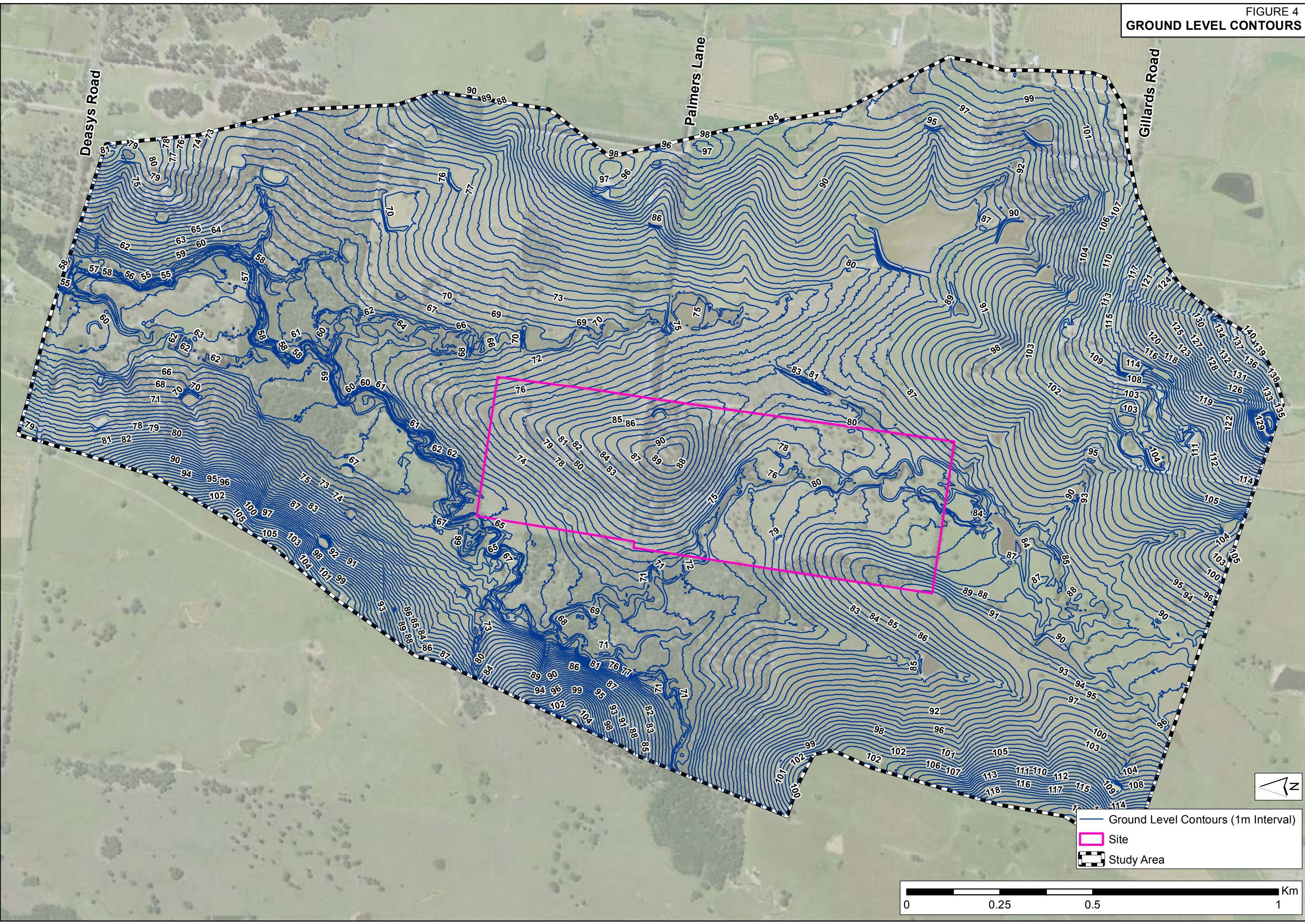


FIGURE 5
PEAK FLOOD LEVELS AND DEPTHS
5% AEP EVENT

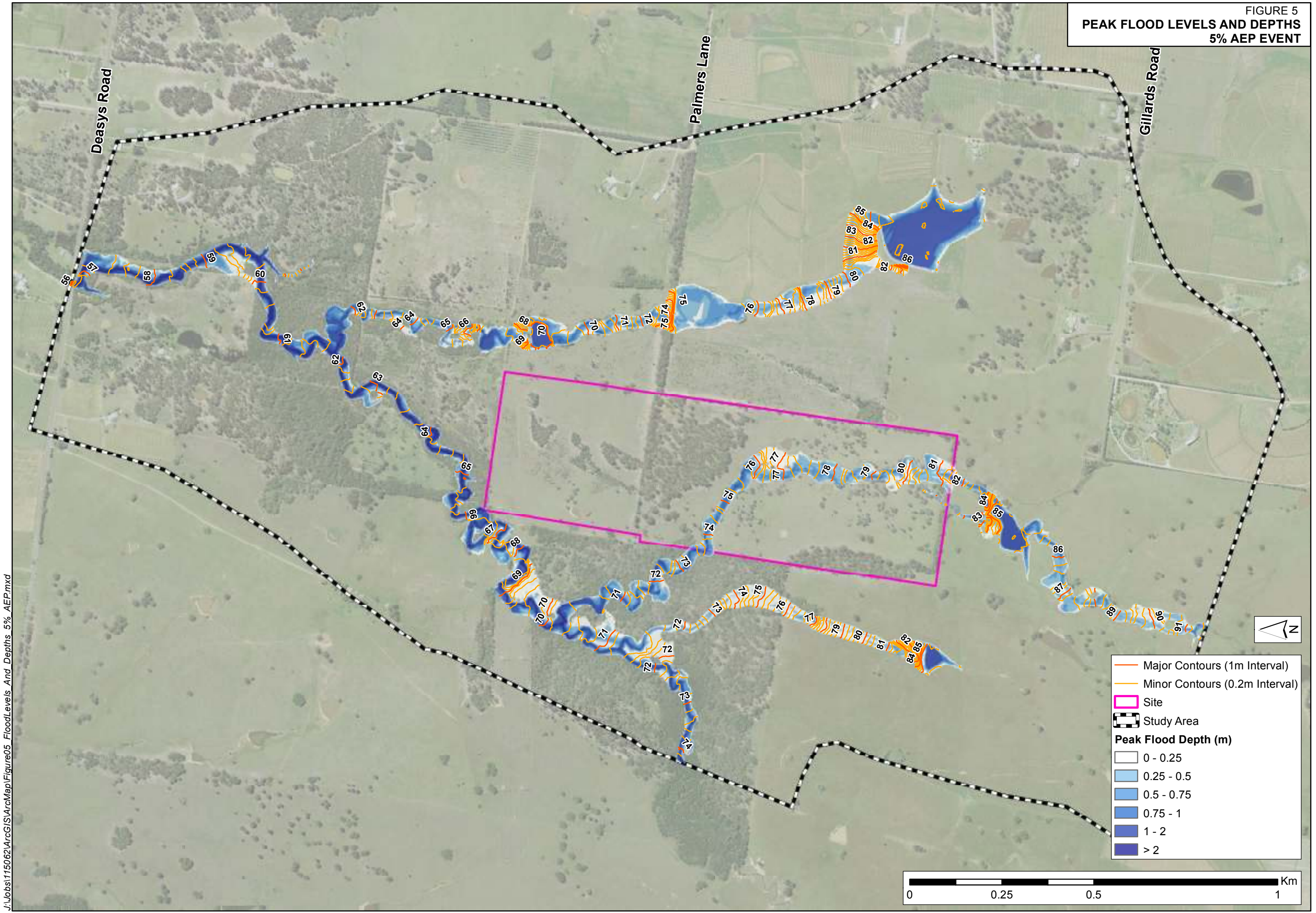


FIGURE 6
PEAK FLOOD LEVELS AND DEPTHS
1% AEP EVENT

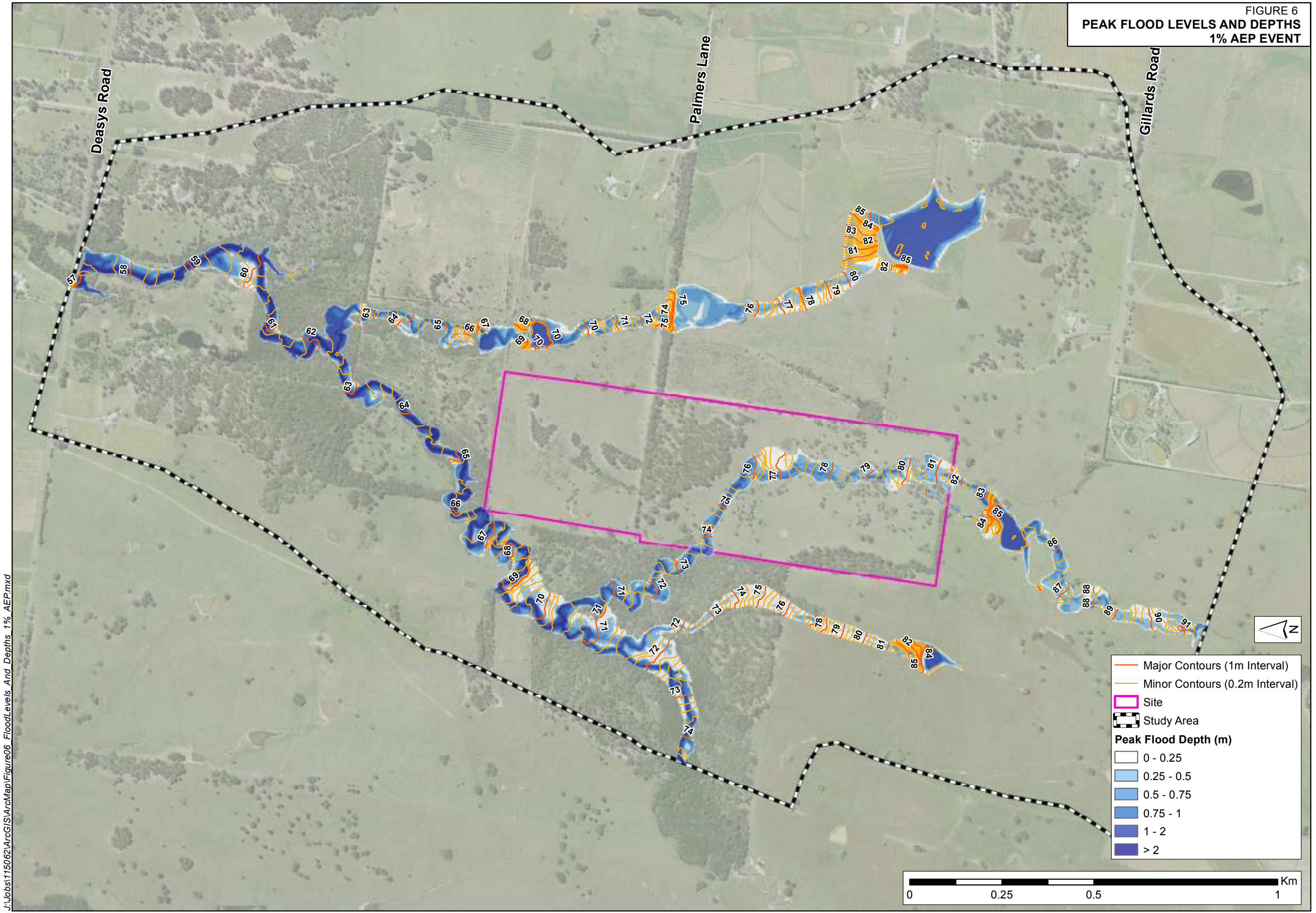


FIGURE 7
PEAK FLOOD LEVELS AND DEPTHS
PMF EVENT

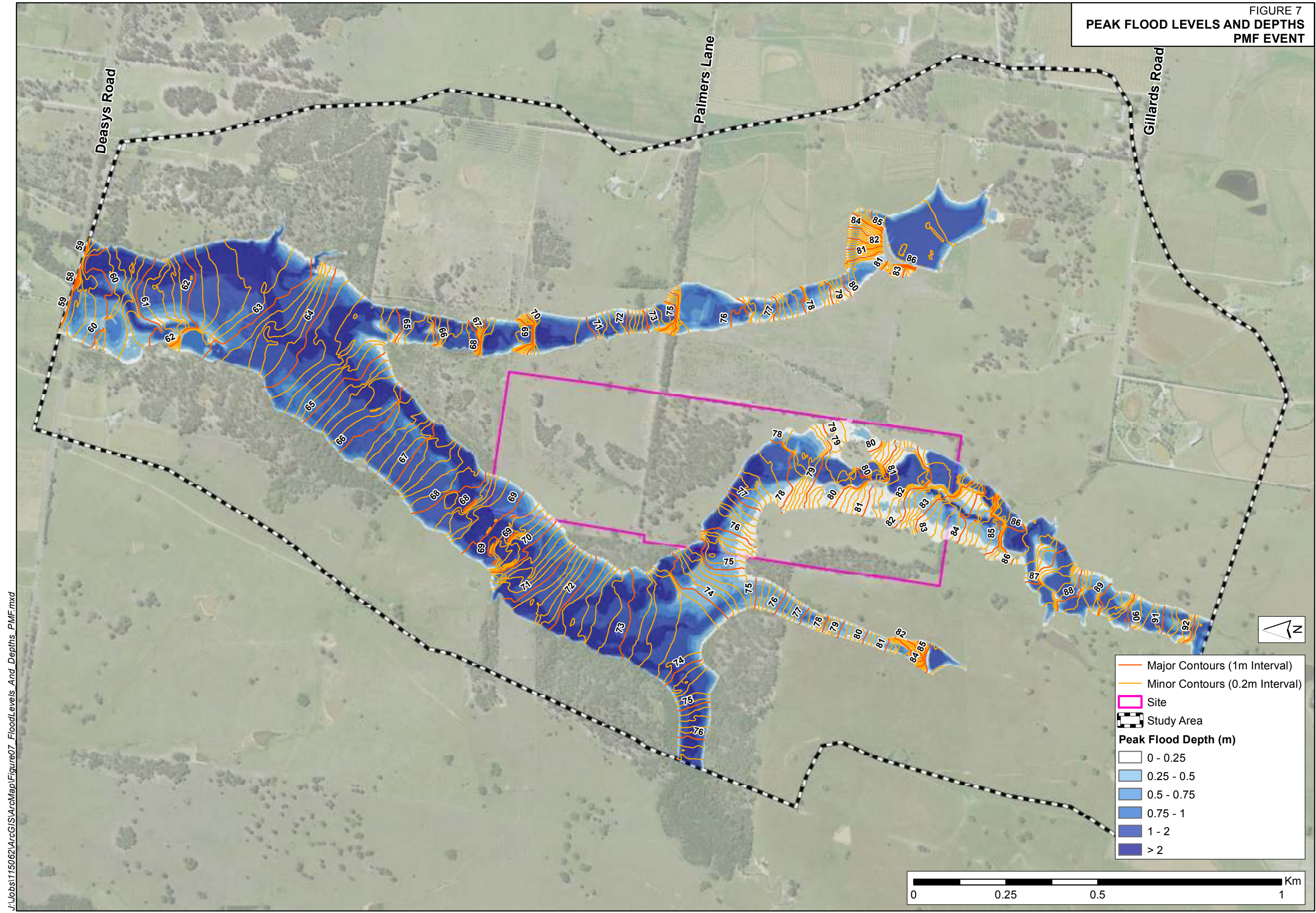


FIGURE 8
PEAK FLOOD VELOCITY
5% AEP EVENT

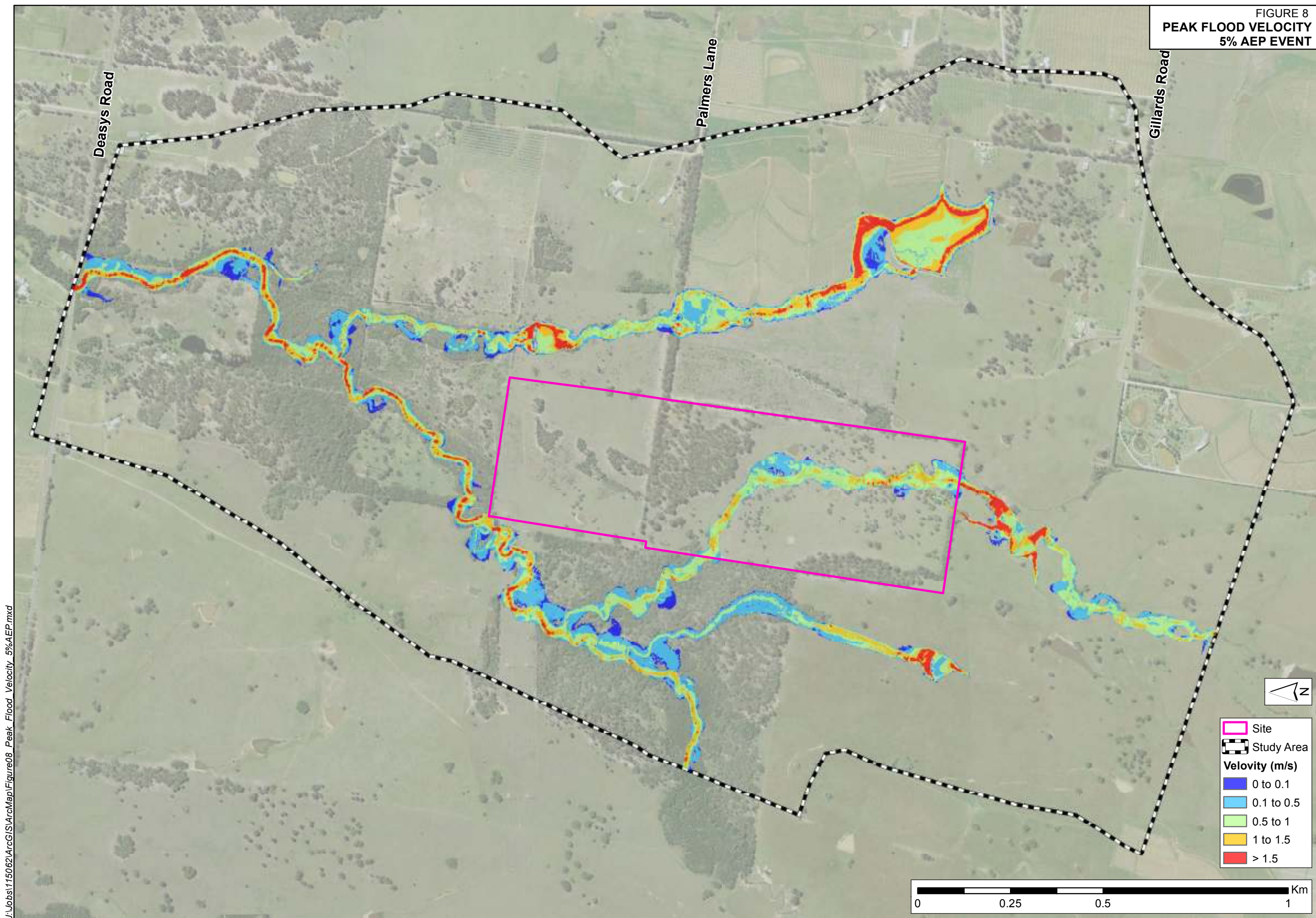


FIGURE 9
PEAK FLOOD VELOCITY
1% AEP EVENT

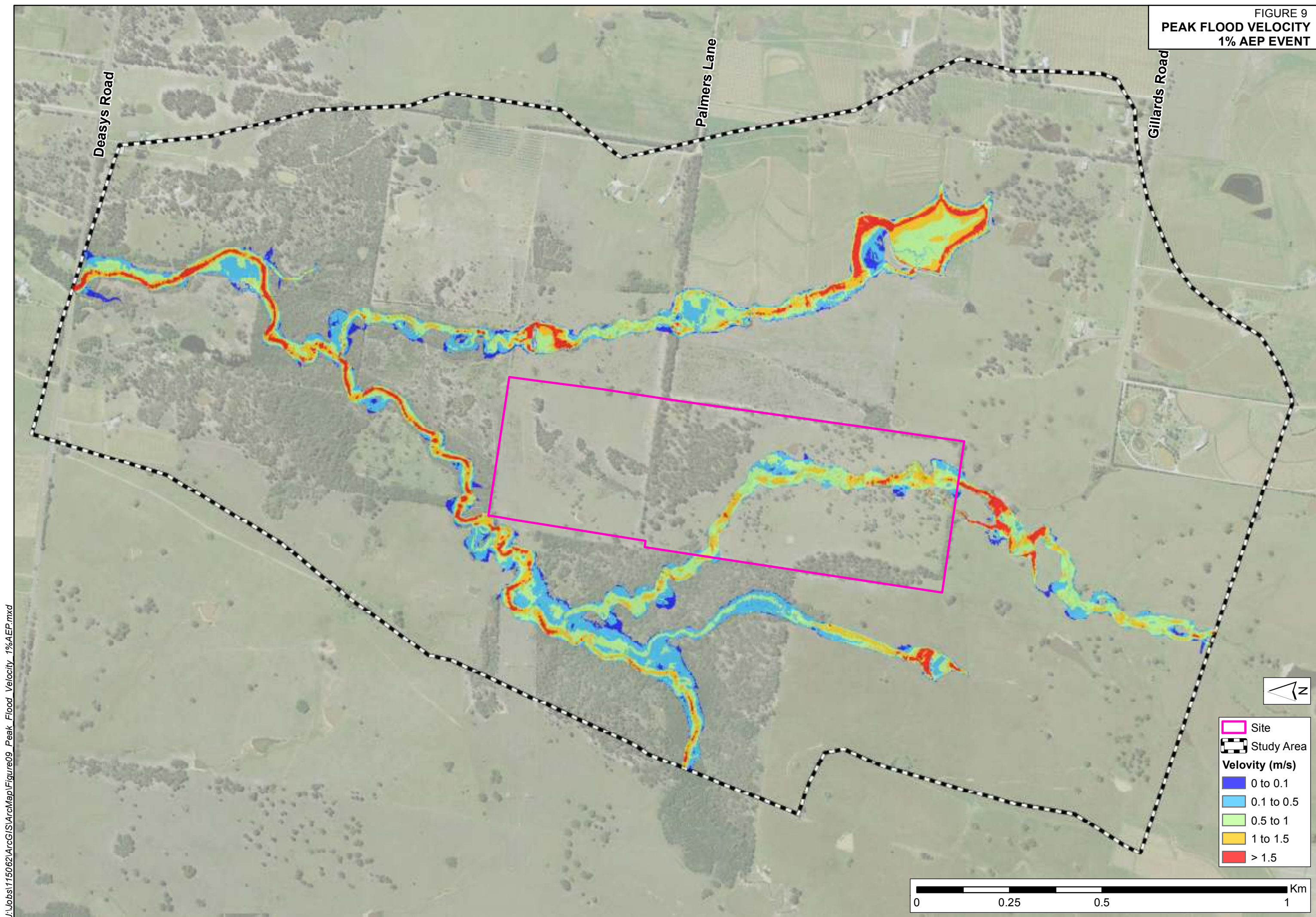


FIGURE 10
PEAK FLOOD VELOCITY
PMF EVENT

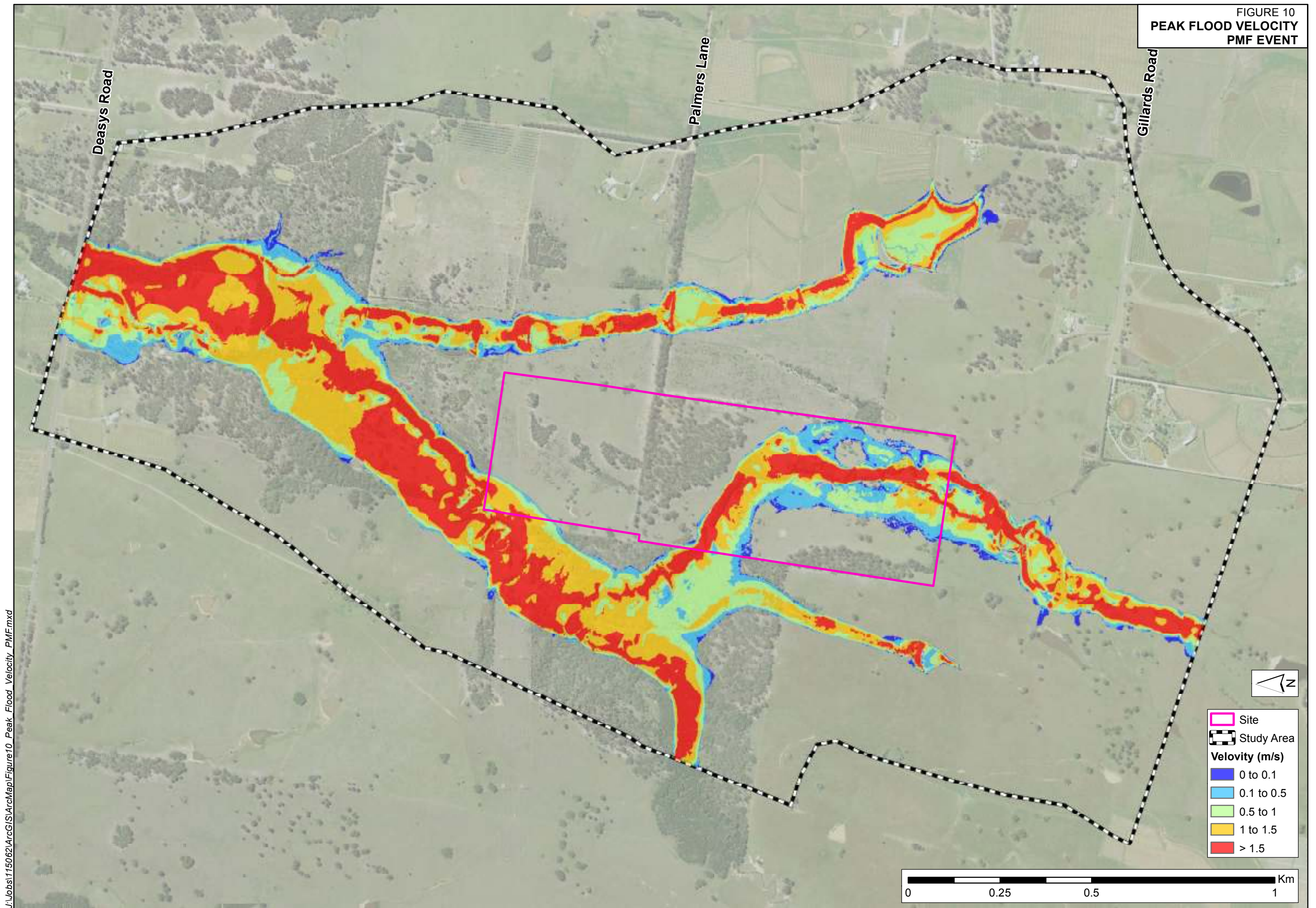


FIGURE 11
HYDRAULIC HAZARD
5% AEP EVENT

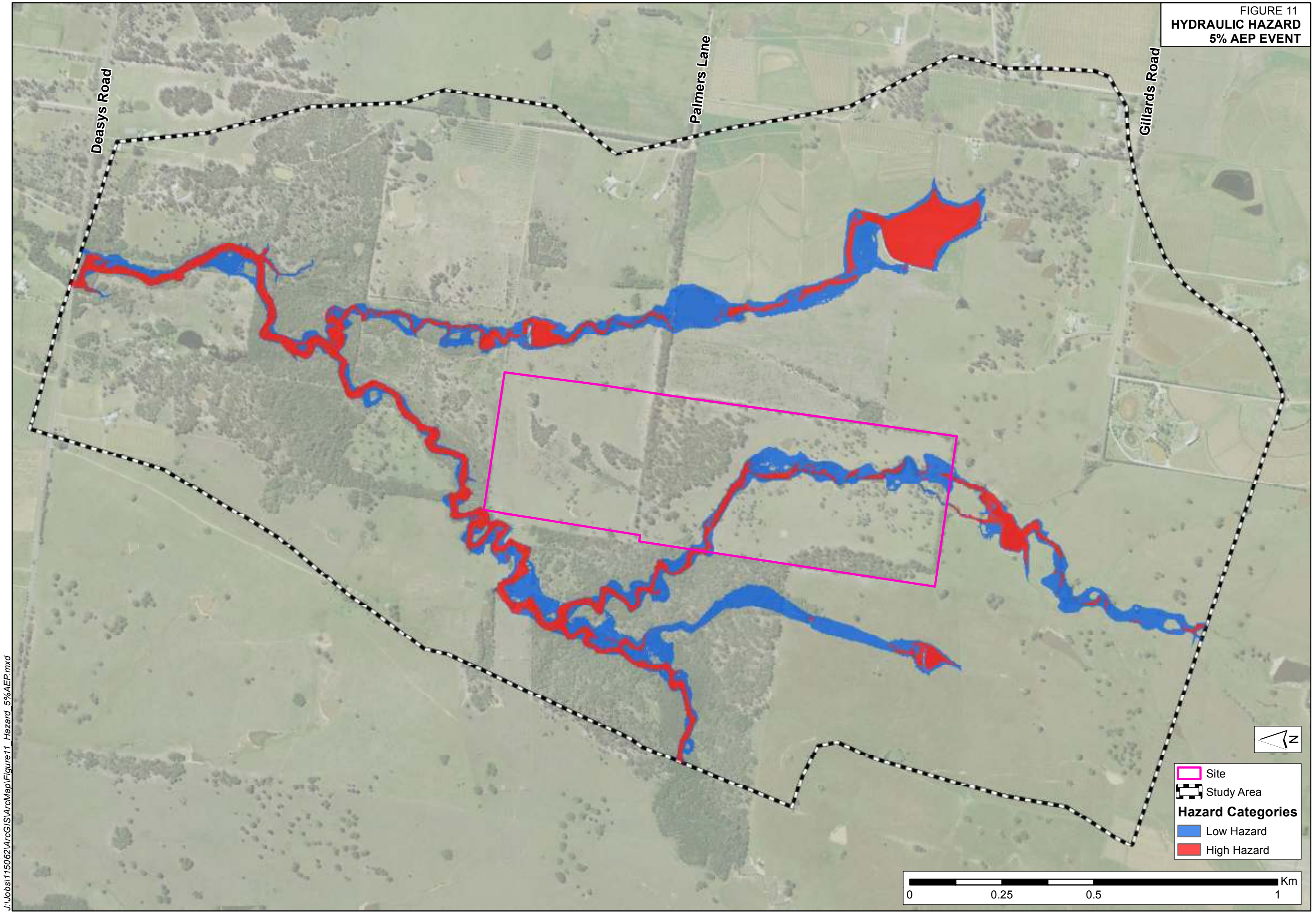


FIGURE 12
HYDRAULIC HAZARD
1% AEP EVENT

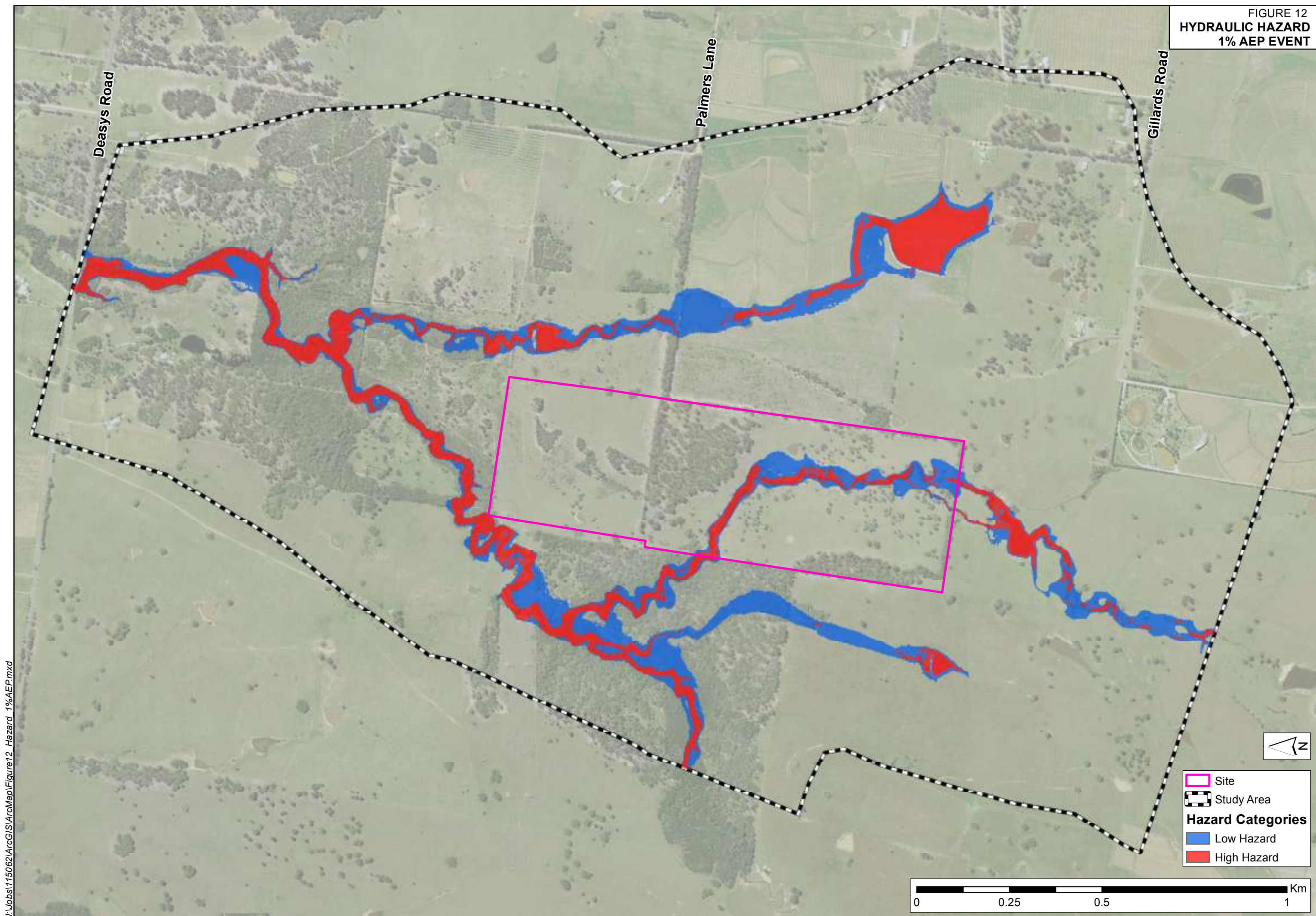


FIGURE 13
HYDRAULIC HAZARD
PMF EVENT

